

Climate Change

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Abstract

In the period since the Industrial Revolution, human emissions of greenhouse gases from fossil fuel combustion, deforestation and agricultural practices have led to global warming and climate change. Observed and anticipated changes in the climate include higher temperatures, changes in rainfall patterns, changes in the frequency and distribution of weather events such as droughts, storms, floods and heat waves, sea level rise and consequent impacts on human and natural systems. Many scientists argue that the impacts of climate change will be devastating for natural and human systems and that climate change poses an existential threat to human civilisation. However, action to respond to climate change has been slow. Climate change draws attention to the relationship between science and society, challenges global governance institutions, and triggers new social movements. Engagement with climate change by social scientists is prompting conceptual renewal in areas such as social practice theory, and transition and transformation studies.

Overview

“Climate” is the average of the weather conditions at a particular point on the Earth. Typically, climate is expressed in terms of expected temperature, rainfall and wind conditions based on historical observations. “Climate change” is a change in either the average climate or climate variability that persists over an extended period.

The Earth’s climate has always changed. Changes in the Earth’s orbit, the energy output of the sun, volcanic activity, the geographic distribution of the Earth’s land masses and other internal or external processes can influence climate. Scientists refer to this type of long-term climate change as “natural

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climate change”. As a result of natural climate change, the Earth has experienced regular cold periods (or ice ages) in the past, when glaciers covered large parts of the Earth’s surface. The Earth has also experienced warmer periods when sea levels were much higher than they are now. In the Earth’s long-term history, the current period is characterised by a relatively warm, stable climate that has lasted since the end of the last ice age about 11,700 years ago. This period is known to geologists as the Holocene and is the period during which human civilisation has flourished.

If this were the only type of climate change, then the interest to sociologists would be minimal. However, scientific observations and models indicate that the Earth’s climate is now changing due to human activity. This is termed “anthropogenic climate change”. The processes involved are complex but can be summarised as follows. Human activities, such as burning fossil fuels (coal, oil and natural gas) to make electricity and power vehicles, clearing forests for farms and cities, and cultivating livestock, release “greenhouse gases” into the atmosphere. The main greenhouse gases are carbon dioxide, methane, halocarbons, and nitrous oxide. These gases accumulate in the atmosphere and allow radiation from the sun to pass through but trap some of the heat radiating back from the Earth. This is called the “greenhouse effect” because the principle is similar to a greenhouse, where the glass roof allows sunlight in but traps heat for growing plants.

Over time, the enhanced greenhouse effect results in “global warming” - an increase in the Earth’s average temperature. Global warming is one type of climate change and it drives other changes in the climate, such as changes in rainfall patterns and the frequency and distribution of weather events such as droughts, storms, floods and heat waves. Although the terms climate change and global warming are often used interchangeably, climate change is a broader term that incorporates both global warming and other observed changes in climate. Many scientists argue that the impacts of climate change will be devastating for natural and human systems and that climate change poses an existential threat to human civilisation.

A key question for sociologists, posed by Anthony Giddens (2011), is why a threat of such magnitude is routinely ignored by our societies. Giddens’ response, which he calls the “Giddens Paradox”, is that the lack of tangible, immediate danger from climate change means that most will do nothing to respond. Yet by the time the danger becomes clearly visible, it will be too late

to act due to the lag between the emission of greenhouse gases and their full warming impact. At the point where the danger becomes too great to ignore, further warming will be locked in by emissions already in the atmosphere. For many sociologists, finding a pathway out of this paradox is a key concern.

Climate change is also of interest to sociologists because the activities that are responsible for anthropogenic climate change are embedded in human social life. Everyday social practices like eating, working, moving about, and heating and cooling our homes result in emissions of greenhouse gases that contribute to climate change. Further, the causes and impacts of climate change are unevenly distributed, raising questions of social justice. In general, wealthier countries produce more greenhouse gas emissions per person, whereas poorer countries tend to be more vulnerable to the impacts of climate change. Proposed responses to climate change also have social impacts that are unevenly distributed. Consequently, climate change poses the first truly global social dilemma, and it is one that has proven politically intractable at multiple governance scales.

The science of climate change

Our senses are good at identifying short-term environmental changes but not so good at noticing long-term climate changes. We rely on climate science, rather than our own senses, to identify climate change. Climate science relies on long-term monitoring and records of climate data such as temperature and rainfall, reconstructions of past climate, and projections of future climate using models of the climate system.

The foundation for the modern scientific view of climate change emerged during the 19th Century when evidence of past glaciation led to the realisation that the Earth's climate was not stable and had changed substantially over time. Recognition of natural climate change paved the way for the idea that humans could also alter the climate. In 1896, the chemist Svante Arrhenius proposed that human emissions of carbon dioxide would strengthen the natural greenhouse effect, thereby raising the Earth's temperature. However, it was not until the 1960s and 1970s that the idea of anthropogenic climate change began to gain scientific momentum, coinciding with the emergence of environmentalism.

In the 1980s, global warming became dominant scientific opinion. A key development was the establishment of the Intergovernmental Panel on Climate

Change (IPCC) by the United Nations Environment Programme and the World Meteorological Organization in 1988. The IPCC reviews and assesses scientific, technical, and socio-economic information produced worldwide that is relevant to the understanding of climate change. It does not conduct its own research or monitoring; instead, it produces summaries or Assessment Reports. It has published five such Assessment Reports to date: in 1990; 1995; 2001; 2007 and 2013-14. Each report typically comprises four volumes. The first three volumes focus on: the physical science basis for climate change; impacts, adaptation, and vulnerability; and mitigation of climate change. The fourth is a synthesis report. Thousands of scientists from around the world voluntarily contribute their time to the development of the IPCC reports as authors or reviewers. The 195 governments that are members of the IPCC also contribute to the review process and endorse the IPCC reports. The reports are the authoritative source of scientific information on climate change.

The Fifth Assessment Report states that warming of the climate system is unequivocal, that the atmosphere and ocean have warmed, snow and ice have melted, sea level has risen and greenhouse gas concentrations have increased (Stocker et al., 2013). The report finds that the largest contributor to observed warming is the increase in carbon dioxide in the atmosphere and that it is “extremely likely” that human influence has been the dominant cause of this warming since the mid-20th century (Stocker et al., 2013). These changes, and projected future changes, pose risks to human and natural systems that could be catastrophic if unchecked. Key reasons for concern include: threats to unique ecosystems and cultures; increased incidence of extreme weather events; disproportionate impacts on disadvantaged communities; global aggregate impacts on biodiversity and the economy; and the risk of large-scale singular events such as ice sheet loss (Field et al., 2014).

There are two kinds of response to the threat identified by climate scientists: adaptation and mitigation. Adaptation is a process of adjustment to climate change, in which humans take action to moderate or avoid negative impacts, and exploit beneficial opportunities. This could involve shifting to crops that thrive in the modified climate conditions, or building coastal defences to protect against sea level rise. The other option is mitigation, or reduction in human emissions of greenhouse gases to reduce the extent of climate change. Human greenhouse gas emissions come primarily from combustion of fossil fuels, deforestation, and agricultural practices. Mitigation means replacing fossil

fuels with renewable or low-emission alternatives, protecting and planting forests, and shifting agricultural practices. The challenge is that costs are incurred in moving from the current techno-economic system to low- or zero-emission alternatives.

The scientific consensus presented in the IPCC reports is not uncontroversial. Although more than 97% of peer-reviewed articles that express a view on climate change endorse the consensus that humans are causing global warming (Cook et al., 2013), a very small number of scientists and a much larger number of non-scientists disagree with this consensus. Some argue that the Earth is not warming at all. Others accept that the Earth is warming but argue that the causes are predominantly natural. Both of these positions conflict with the weight of scientific evidence presented by the IPCC. A third group accepts the view that humans are causing climate change but argues that the risks of climate change are negligible or even positive.

Clearly, these different positions have very different implications for policy and action. The result has been a raucous debate over whether and how to respond to climate change. For sociologists, the emergence of these different positions is of interest and raises questions about the interface between science and society. The IPCC explicitly strives to present findings that are policy-relevant and policy-neutral, not policy-prescriptive. Yet societies have so far chosen not to take action on climate change that is proportional to the degree of threat presented by the IPCC. Indeed, climate scientists have been accused of fabricating results and participating in a conspiracy to secure ongoing research funding.

These social reactions to the scientific consensus signal a changing relationship between science and society. Social scientists such as Sheila Jasanoff contend that knowledge is co-produced, so that the ways in which we know and represent the world are inseparable from the ways we choose to live in it (Jasanoff, 2004). All knowledge is socially embedded so, in this view, the attempts of the IPCC to disentangle its scientific assessment from policy-making are misguided. Jasanoff (2010) argues that the IPCC process detaches knowledge from meaning and that the climate science consensus goes against the grain of common sense. Climate change is temporally and spatially distant from our lived experience and abstracted from the social life of our communities. Our understanding of climate change draws on abstract scientific models, projections and probabilities that are difficult to connect to our

everyday lives. Jasanoff sees an important role for the social sciences in reintegrating scientific representations of the climate with social responses to those representations.

The governance of climate change

The challenges of responding to climate change identified by Jasanoff are exacerbated by the global nature of the problem. New global governance institutions have emerged in an attempt to coordinate an effective response. The first major intergovernmental conference on climate change took place in Toronto, Canada in 1988 and produced a statement calling for a 20 per cent reduction in greenhouse gas emissions by 2005. In 1992, the Rio Earth Summit adopted the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC is an international treaty, ratified by 195 countries, which first came into force on 21 March 1994. Its objective is to stabilise greenhouse gas concentrations in the atmosphere at a level that prevents dangerous human interference with the climate system. Each year, the Parties to the UNFCCC meet for a Conference of the Parties to try and make progress in developing institutions to achieve this objective.

In 1997, the Parties to the UNFCCC adopted the Kyoto Protocol as a first attempt to introduce binding emission reduction commitments, for developed countries only. The commitments in the Kyoto Protocol added up to a five per cent reduction in emissions from developed countries between 1990 and 2012. However, resistance from some countries meant that the Kyoto Protocol did not come into force until 16 February 2005. Some countries, most notably the United States, never ratified the Kyoto Protocol.

Attention subsequently turned to the negotiation of a treaty that would include the United States and major developing economies. At the time of writing, these negotiations are ongoing, but some progress has been achieved. First, in 2010, Parties agreed to limit average global warming to no more than two degrees Celsius. Many scientists argue that this is the maximum safe level of climate change to which societies can successfully adapt. The target will be reviewed in 2015 to determine whether a lower target of 1.5 degrees Celsius is appropriate. Second, the countries responsible for most of the global greenhouse gas emissions have now made official emission reduction pledges under the UNFCCC. While these pledges are not yet legally binding, and they fall short of the emission reductions needed to meet the two degrees goal, the pledges are

significant because they bring developing economies into the commitment process. Third, in 2011, countries set a goal to negotiate a new legal instrument by 2015 to cover emission reductions beyond 2020.

Nevertheless, progress in these negotiations has been slow. Global greenhouse gas emissions continue to grow and national pledges to reduce emissions currently fall well short of what is required to limit global warming to no more than two degrees. There are several crucial challenges that hinder progress. First, the UNFCCC processes require consensus to make decisions. With so many countries involved, having so many different interests, achieving consensus is extremely challenging. Second, not all of the political parties that make up national governments accept the scientific consensus on climate change or its implications. Some countries, particularly those that rely on exports of fossil fuels, have significant economic interest in maintaining the status quo. The requirement for consensus means that these countries can readily prevent progress. Third, there is an ongoing debate about equity and burden sharing. The UNFCCC includes a principle that developed countries should act first to reduce emissions, given their historical responsibility for a greater share of emissions and their greater resources to act. This is why the Kyoto Protocol established emission reduction targets only for developed countries. Now, however, developing economies like China, Brazil and India are responsible for a growing share of global greenhouse gas emissions. These countries are being asked to make emission reduction commitments even though their historical responsibility for the problem and emissions per person are generally lower than developed countries. Many developing countries have concerns about the level of ambition of targets set by the developed countries and their level of commitment to financing and support for emission reductions in poorer countries.

The situation constitutes a “social dilemma”. It is in the best interests of all countries to develop an effective response to climate change. But a country that acts first runs the risk of incurring economic penalties that are not incurred by competing countries, while also not gaining the benefits of action if not enough countries act alongside them. Thus, there is little incentive for leadership.

Numerous responses to the slow progress of the international climate change negotiations have been proposed. One argument, from a social justice perspective, is that an eventual treaty must be structured around the principle of

“contraction and convergence”. In this framework, all countries would be expected to converge on a target for emissions per person that would deliver a safe climate. Currently, for example, the United States emits almost 20 tonnes of greenhouse gas per person compared to 7.6 tonnes in China, 1.9 tonnes in India and 0.8 in Haiti. Wealthy countries would need to substantially reduce their emissions, while some poorer countries may have room to grow their emissions. Developed countries have largely resisted this model in the negotiations.

Another argument is that negotiations should move from the UNFCCC to a more manageable setting, such as the G20, where fewer countries would need to reach agreement. The challenge here is that many of the major disagreements in the negotiations are between G20 members.

A third argument, put forward most famously by Elinor Ostrom (2009), is that we should place less faith in the international negotiations as the central site of global climate change response and adopt instead a polycentric approach. This means pursuing actions to respond to climate change at local, regional and national levels as well as the international, involving governments, business and civil society, and across multiple sectors. This is a call for a more distributed governance of climate change, in which diverse actors all have a role to play. Giddens (2011) adopts a similar position, arguing that leadership must come from particular nations showing the way, rather than waiting for a global deal.

A fourth perspective is to seek systemic democratisation of new and existing institutions for climate change governance by creating and facilitating opportunities for deliberation wherever they exist (Stevenson and Dryzek, 2014).

Social movements and climate change

Many people around the world that accept the scientific consensus on climate change are dissatisfied with the pace of the international negotiations and the extent of action by governments and businesses at all levels. In response, social movements for stronger action on climate change have emerged across the world. This “climate action movement” has no central organisation but is a shifting conglomeration of concerned individuals, non-government organisations, progressive businesses and some governments or government agencies. Although dominated by environmental interests, the climate action movement increasingly includes social justice groups, the labour and workforce

rights movement, faith groups, charitable institutions and the aid and development sector.

The climate action movement uses typical social movement tactics such as protests, rallies, civil disobedience and rhetoric to raise the profile of climate change and advocate for urgent action. The movement is very visible at international negotiations, both inside and outside the venues. It has even run its own parallel negotiations, such as the World People's Conference on Climate Change and the Rights of Mother Earth in Bolivia in 2010, resulting in a People's Accord. The movement also holds coordinated global action days. In October 2009, ahead of the Copenhagen Conference of the Parties to the UNFCCC, 350.org orchestrated simultaneous rallies in 181 countries, claiming this as the largest coordinated protest in history.

Recent years have seen a shift in movement tactics, prompted by the impasse in international political negotiations. The amount of carbon humans can still emit while having a reasonable chance of staying below two degrees is referred to as the "global carbon budget". At present emission rates, the global carbon budget will be exhausted in about 30 years (Global Carbon Project, 2014). In an influential 2012 article in *Rolling Stone* magazine, prominent climate activist Bill McKibben demonstrated that only about a fifth of the known reserves of fossil fuels could be burnt if we wish to keep global warming to less than two degrees. The companies and governments that own these fossil fuel reserves act as if they will be able to burn them all, and are valued on the market as such. McKibben positioned the fossil fuel industry as the enemy of the climate action movement and urged activists to work to break their power. This has opened up a new movement focus on divestment of fossil fuel investments. Around the world, activists are now pressuring diverse organisations to cease any investment in the fossil fuel industry.

The social science of climate change

Some argue that social scientists have been late to engage with climate change, given its serious social implications (e.g. Lever-Tracy, 2010, pp. 1). Others argue that social scientists have been engaging with climate change but that most of their discussions are inward-looking or divorced from the limited range of social theories – such as behavioural economics and psychology – that have a privileged position in policy making on climate change (Shove, 2010). What is abundantly clear is that the problem of climate change is typically framed in the

terms of natural science, or in terms of technological and economic responses, and much more rarely in sociological terms. Yet, the intractability of climate change from these perspectives has led to broader recognition that climate change is a social problem, in which issues of social justice, the social construction of knowledge, the influence of social norms, and the everyday social practices in which people engage are critical.

In the engagement between the social sciences and climate change, climate change is often used as a lens through which to explore classic social theoretical problems (Shove, 2010). For example, many authors use climate change as a case study to demonstrate that construction and definition of societal problems is an inherently selective product of cultural and political power. One strand of such work focuses on the social justice implications of climate change, pointing out that those responsible for most of the global greenhouse gas emissions are the wealthy, while the impacts fall disproportionately on the poor. In this framing, the “luxury emissions” of the wealthy are very different to the “survival emissions” of the poor and power relations shape the existing political impasse on climate change.

Other prominent work of this type identifies diverse social groupings and discourses, and their differing orientations to climate change. Divisions might be based on the orientation towards climate science. For example, those who reject climate science are labelled climate sceptics, or climate deniers, and much social work explores the social (and psychological) reasons for denial. Or, in an alternative framing, grid-group cultural theory identifies four distinct orientations towards climate change with very different stories about the problems and solutions: egalitarians; hierarchists; individualists; and fatalists (Verweij et al., 2006). As Shove points out, all of these approaches point to the diverse framings and discourses of climate change and the inevitable social contestation and disagreement that results. These are not new findings but they are drawn into sharp relief by the responses to climate change.

Climate change also offers a lens through which to critique current forms of capitalism and their commitment to endless economic growth. Again, such criticisms are not new, but the realisation of the finite capacity of the Earth to cope with human greenhouse gas emissions does underline the fallacy of existing economic models that assume infinite capacity for growth in material consumption. John Urry (2011) is one of the many that have written on the need

for transformation of economic systems, consumption patterns and consumer culture to respond successfully to climate change.

While social scientific work on climate change often reinscribes old theoretical problems, climate change is also a contributor to conceptual renewal (Shove, 2010). This is particularly evident in recent work on social practices, transitions, and transformative pathways.

Social practices and climate change

One of the great challenges posed by climate change is its ubiquity. Previous large-scale environmental problems, like acid rain and ozone depletion, could be addressed without widespread change in the structure of human society. In the case of ozone depletion, the Montreal Protocol on Substances that Deplete the Ozone Layer effectively phased out production of ozone depleting substances, replacing them with technological alternatives at little additional cost. For climate change, no such easy technological alternatives exist. The use of cheap, portable fossil fuels is a fundamental attribute of current techno-economic systems that underpins the everyday practices of billions of people around the world. While technological alternatives do exist, they often cost more or disrupt existing social practices. For example, the production of red meat is a significant source of greenhouse gas emissions and there are few low-cost technological interventions to reduce livestock emissions. Reducing meat consumption is possible but is a significant change to current eating practices.

This realisation that climate change is embedded in everyday practices – the way we light, heat and cool our homes, move about and eat – has seen social practice theory come to the fore as a sociological frame for exploring climate change. Social practice theory frames practices, instead of individual agents or social structures, as the central unit of social analysis. Practices are routinized integrations of several elements, including materials, meanings, and competences (Shove, Pantzar and Watson, 2012). Each of the elements needs to be present for the practice to be enacted. For example, the social practice of driving integrates: materials such as a car and roads; competence in driving a vehicle; and meanings such local driving rules and conventions. Changing social practices in response to climate change is beyond the ability of any single individual. While a social practice perspective challenges the simple behavioural approaches to climate change response that dominate policy-

making, it opens up new inquiries into the dynamics of social practices and their elements.

Transition studies

Transition studies is a second area where climate change prompts conceptual renewal. A transition is a set of reinforcing changes in the interlocking technologies, practices, markets, institutions, infrastructure, cultures and values that make up society. Transition theories draw on multiple strands of work, including innovation studies, socio-technical transition theories such as the multi-level perspective, strategic niche management, and science and technology studies.

While transition theories are diverse, there are several common concepts (Grin, Rotmans and Schot, 2010). The first is the idea that economic, cultural, technological, ecological, and institutional subsystems co-evolve in ways that can reinforce each other, working for or against a transition. The second is the multi-level perspective, which conceives of a transition as the interaction between three levels: innovative practices (niches); dominant structure (the regime); and long-term exogenous trends (the landscape). Niches have relative freedom to rapidly experiment, whereas the regime and landscape are increasingly structured and slow moving. The third concept is the idea that transitions move through four phases over time: a pre-development phase where the status quo is changing but changes are not yet visible; a take-off phase where structural change picks up momentum; an acceleration phase in which structural changes become visible; and a stabilisation phase where a new equilibrium is formed. Finally, transition theories emphasise co-design and learning.

The emergence and popularity of transition theories is a response to the “locked in” character of existing fossil energy systems and their resistance to change. Several decades of scientific warnings and social movement action have not led to reductions in global greenhouse gas emissions. Yet the underlying equilibrium is undoubtedly shifting and rapid deployment of some technologies, such as solar photovoltaic power, may represent the first signs of take-off and acceleration in regime change.

Transformative pathways

Building on transition theory, social scientists have been prominent in the emergence of a new research agenda on transformative pathways beyond climate change. Transformation literally means a marked change in form and the term is used to draw attention to the scale and breadth of the changes needed to successfully respond to climate change. Nothing less than a transformation of existing societies is needed, and the transformation will involve technologies, the economy, institutions, practices, cultures, and value systems.

The International Social Science Council has been prominent in calls for transformation, releasing a report in 2012 on Transformative Cornerstones of Social Science Research on Global Change (Hackmann and St Clair, 2012) and including transformation as a major theme in the 2013 World Social Science Report (ISSCUNESCO, 2013). Transformation also features heavily in the research program of the Future Earth initiative, a major global sustainability research hub.

Cross references

SEE ALSO: Discourse; Environment, Sociology of the; Environmental Movements; Environmental Problems; Global Warming; Grid and Group; Scientific Knowledge, Sociology of; Social Dilemmas; Social Movements; Social Practices

References

Cook, J., Nuccitelli, D., Green, S. A., Richardson, M., Winkler, B., Painting, R., Way, R., Jacobs, P. and Skuce, A. (2013) 'Quantifying the consensus on anthropogenic global warming in the scientific literature', *Environmental Research Letters*. IOP Publishing, 8(2), p. 024024. doi: 10.1088/1748-9326/8/2/024024.

Field, C. B., Barros, V. R., Dokken, D. J., Mach, K. J., MD, M., Bilir, T. E., Chatterjee, M., KL, E., Estrada, Y. O., Genova, R. C., Girma, B., Kissel, E. S., Levy, A. N., MacCracken, S., Mastrandea, P. R. and White, L. L. (eds) (2014) *Climate Change 2014: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

Giddens, A. (2011) *The Politics of Climate Change*. Second Edition. Cambridge, UK and Malden, USA: Polity Press.

Global Carbon Project (2014) *Carbon budget and trends 2014*. Global Carbon Project. doi: www.globalcarbonproject.org/carbonbudget.

Grin, J., Rotmans, J. and Schot, J. (2010) *Transitions to Sustainable Development*. New York: Routledge.

Hackmann, H. and St Clair, A. (2012) *Transformative cornerstones of social science research for global change*. International Social Science Council. doi: <http://www.worldsocialscience.org/documents/transformative-cornerstones.pdf>.

ISSC and UNESCO (2013) *World Social Science Report 2013, Changing Global Environments*. Paris: OECD Publishing and UNESCO Publishing. doi: 10.1787/9789264203419-en.

Jasanoff, S. (2010) 'A New Climate for Society', *Theory, Culture & Society*. SAGE Publications, 27(2-3), pp. 233–253. doi: 10.1177/0263276409361497.

Jasanoff, S. (ed.) (2004) *States of Knowledge*. London: Routledge.

Lever-Tracy, C. (ed.) (2010) *Routledge Handbook of Climate Change and Society*. Abingdon: Routledge.

Ostrom, E. (2009) *A Polycentric Approach for Coping with Climate Change*. Development Economics, Office of the Senior Vice President and Chief Economist: The World Bank.

Shove, E. (2010) 'Social Theory and Climate Change: Questions Often, Sometimes and Not Yet Asked', *Theory, Culture & Society*. SAGE Publications, 27(2-3), pp. 277–288. doi: 10.1177/0263276410361498.

Shove, E., Pantzar, M. and Watson, M. (2012) *The Dynamics of Social Practice*. London: SAGE.

Stevenson, H. and Dryzek, J. S. (2014) *Democratizing Global Climate Governance*. Cambridge, UK: Cambridge University Press.

Stocker, T. F., Plattner, G. K., Tignor, M., Allen, S. K., Boschung, J., Nauels, A., Xia, Y., Bex, V. and Midgley, P. M. (eds) (2013) *Climate Change 2013: The Physical Science Basis. Contribution of Working Group 1 to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

Urry, J. (2011) *Climate Change and Society*. Cambridge, UK and Malden, USA: Polity Press.

Verweij, M., Douglas, M., Ellis, R., Engel, C., Hendriks, F., Lohmann, S., Ney, S., Rayner, S. and Thompson, M. (2006) 'Clumsy Solutions for a Complex World: The Case of Climate Change', *Public Administration*. Blackwell Publishing Ltd, 84(4), pp. 817–843. doi: 10.1111/j.1540-8159.2005.09566.x-i1.